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BOX: PATENT APPLICATION

Assistant Commissioner for Patents
Washington, D.C. 20231

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Re: Application of Masahiko YAMADA
METHOD AND UNIT FOR STORING A RADIATION IMAGE
Our Reference: Q56564

Dear Sir:

Attached hereto is the application identified above including the specification, claims, executed Declaration and Power of Attorney, six (6) sheets of drawings, two (2) priority documents, Information Disclosure Statement and PTO Form 1449 with references, executed Assignment and PTO Form 1595.

The Government filing fee is calculated as follows:

Total Claims	30 - 20 =	10 x \$18 =	\$ 180.00
Independent Claims	2 - 3 =	0 x \$78 =	\$ 000.00
Base Filing Fee	(\$690.00)		\$ 690.00
Multiple Dep. Claim Fee	(\$260.00)		\$ 000.00
TOTAL FILING FEE			\$ 870.00
Recordation of Assignment Fee			\$ 40.00
TOTAL U.S. GOVERNMENT FEE			\$ 910.00

Checks for the statutory filing fee of \$ 870.00 and Assignment recordation fee of \$ 40.00 are attached. You are also directed and authorized to charge or credit any difference or overpayment to Deposit Account No. 19-4880. The Commissioner is hereby authorized to charge any fees under 37 C.F.R. 1.16 and 1.17 and any petitions for extension of time under 37 C.F.R. 1.136 which may be required during the entire pendency of the application to Deposit Account No. 19-4880. A duplicate copy of this transmittal letter is attached.

Priority is claimed from:

Japanese Patent Application

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(patent) 321463/1999

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Respectfully submitted,
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METHOD AND UNIT FOR STORING A RADIATION IMAGE

BACKGROUND OF THE INVENTION

Field of the Invention

5 This invention relates generally to a method and unit for storing a radiation image, and more particularly to a method and unit for storing information on a measurement made on a radiation image which is displayed on the display screen of an image display unit, along with the radiation
10 image.

Description of the Related Art

 A computed radiographic (CR) system has recently been put to practical use to obtain radiation images ranging over a very wide radiation exposing area. In this CR system,
15 the radiation-image information of a subject such as a human body is temporarily recorded on an accumulative fluorescent sheet. The accumulative fluorescent sheet accumulates part of the energy of radiation (X-rays, α -rays, β -rays, γ -rays, electron rays, ultraviolet rays, etc.) if the radiation is
20 emitted, and emits accelerated fluorescent light in accordance with the accumulated energy if excitation light such as visible light is emitting, thereafter. The sheet with the image information recorded thereon is scanned by excitation light such as a laser light beam and is caused
25 to emit accelerated fluorescent light corresponding to the image information which is signal light. The emitted

fluorescent light is read by photoelectric reading means such as a photomultiplier, whereby an image signal is obtained. Based on this image signal, the radiation image of the subject is output as the visible image to a storage medium such as photosensitive material and to a display unit such as a cathode-ray tube (CRT) display unit (Japanese Unexamined Patent Publication Nos. 55(1980)-12429, 56(1981)-11395, and 56(1981)-11397).

For the accumulative fluorescent sheet that is employed in the CR system, half size, large-square size, quarter size, one-sixth size, etc., have been prepared according to the photographic object. Also, in order to record a lengthy subject as a single image, investigation has recently been carried out with respect to performing photographing and recording by employing two or more sheets of the existing sizes, such as half size, put side by side, or by employing a sheet longer than the existing sizes.

Incidentally, in orthopedic surgery and the like, among medical fields, the negative film from which a radiation image was output is employed not only for observation and photographing but also for the purposes of measuring scoliotic curvature (Cobb method and Ferguson method) and a kyphotic index. Measuring points are actually marked on the film from which a radiation image was output, and the distance, angle and the like between the marked measuring points are manually measured with a measuring tool such as

a ruler, a protractor and the like. Based on the measured distance and the like, the aforementioned scoliotic curvature and the like are obtained by calculations.

Since, on the other hand, the radiation image
5 obtained by the CR system is digital data as described above, measurements can be made automatically, by displaying the radiation image on the display screen of an image display unit, then specifying measuring points on this display screen, and storing a method of measurement in advance. Furthermore,
10 if methods of calculation for the aforementioned scoliotic curvature and the like are stored, it will become possible to calculate these automatically and the measuring load of a measurer, such as a doctor, a radiation technician and the like, can be reduced appreciably.

15 In the above-mentioned orthopedic surgery and the like, incidentally, the same subject is again measured by photographing a radiation image in order to judge the course of the medical treatment, and the result of measurement is often compared with the previous result of measurement.

20 When making measurements on film, as described above, points on the present film corresponding to the pervious marked points are marked and measured, while the present film is being compared with the previous film on which the previous measurement was made.

25 However, when measurements are made based on the radiation image displayed on the display screen of the image

display unit, as described above, it cannot accurately be grasped which point on the radiation image displayed on the display screen has been measured and what measurement result has been obtained. Particularly, when a doctor or a
5 radiation technician making the present measurement differs from a doctor or the like who made the previous measurement, it is difficult to recognize the previous measuring points and measurement result and there is a problem that an accurate comparison between measurement results cannot be performed.

10 SUMMARY OF THE INVENTION

The present invention has been made in view of the aforementioned circumstances. Accordingly, the object of the present invention is to provide a radiation-image storing method and a radiation-image storing unit which render it
15 easy to recognize the positional information and the like of measuring points afterwards, with respect to a radiation image including measuring points which are predetermined measuring objects, displayed on the display screen of an image display unit.

20 In accordance with one aspect of the present invention, there is provided a storing method comprising the step of:

storing a radiation image displayed on a display screen of an image display unit, the radiation image including
25 a measuring point which is a measuring object; and

wherein positional information of the measuring

point specified on the display screen is stored in a storage medium along with the radiation image.

In a preferred form of the storing method, a result of measurement, obtained based on the positional information, is stored along with the radiation image and the positional information.

The positional information of the measuring point and the measurement result may be stored as numerical information (data), along with the radiation image (data). The positional information and the measurement result may also be stored as image information, which is embedded in the radiation image and displayed. In addition, the positional information and the measurement result may be stored as overlay image information, which is overlaid on the radiation image and displayed. Furthermore, numerical information may be embedded in image information so that it does not disturb diagnosis, as in a digital watermark.

The expression "positional information of the measuring point is stored in a storage medium along with the radiation image" means that the positional information and the radiation image are caused to correspond to each other and are stored in a storage medium, and is not always limited only to integrating the positional information and the radiation information and storing in a single storage medium, as described above, but also includes storing the positional information and the radiation image in separate storage media,

respectively, as long as both are caused to correspond to each other.

It is preferable that the radiation image, which is stored, be an entire image representing the whole of the radiation image and an enlarged image of a portion of the entire image displayed for specifying the measuring point. The reason for this is that an operator (a doctor, a radiation technician, etc.) is able to recognize the position of a specified measuring point as the approximate position on the entire image and also as the detailed position on the enlarged image.

Note that the enlarged image is obtained by enlarging a portion of the entire image displayed on the display screen, indicated by an indicating mark, and also by overwriting and displaying the enlarged portion on an area including the enlarged portion. Also, the enlarged image may be obtained by enlarging and displaying a portion, indicated in the entire image by an indicating mark, on an area on the display screen differing from an area on which the entire image is displayed. That is, an entire image, which represents the whole of a radiation image including a measuring point that is a measuring object, is displayed on the display screen of an image display unit. In the entire image, a portion of the entire image is indicated by an indicating mark and overwritten to an area including that portion indicated by the indicating mark. Alternatively,

the image of a portion of the entire image may be enlarged and displayed on an area on the display screen differing from an area on which the entire image is displayed. The measuring point is specified in the enlarged and displayed image of the aforementioned portion by the indicating mark, whereby detailed positional information of the specified position is acquired. Based on the obtained positional information, the predetermined measurement is carried out, whereby an accurate result of measurement based on an accurate specified position can be obtained.

The expression "enlarge and display a portion of the entire image" does not only mean that a portion of the entire image is enlarged and displayed so that it becomes larger than the portion in the entire image. That is, it will be sufficient if the enlarged and displayed portion is larger than the corresponding portion in the entire image as a result of enlargement. That is, from an accumulative fluorescent sheet, a radiation image is read with high resolution, such as 4280 (vertical) \times 3520 (horizontal) pixels for half size, 8650 (vertical) \times 3520 (horizontal) pixels for two half sizes put side by side, and 12840 (vertical) \times 3520 (horizontal) pixels for three half sizes. However, in an image display unit with resolution which is employed as an ordinary terminal, only a portion of an obtained radiation image can be displayed and therefore there are cases where the number of pixels of the obtained radiation image is reduced to grasp the

positional relation of a measuring point, which is a measuring object, to the entire radiation image and the reduced entire radiation image is displayed. As enlargement display of a portion of the entire image in such a case, a portion of the original radiation image may be displayed at its original size or may be enlarged and displayed, instead of reducing the original radiation image and then enlarging a portion of the reduced entire image.

While an approximate position of a measuring point is being recognized on the displayed entire image whose number of pixels was reduced in this manner, the measuring point can be specified accurately on the image of the enlarged and displayed portion.

The phrase "enlarge and display" has the same meaning as enhancing resolution and displaying, as long as resolution is uniform over the entire display screen. That is, the number of pixels constituting a portion of the entire image, enlarged and displayed, means that it is greater than the number of pixels constituting the corresponding portion displayed as the entire image. Therefore, when an enlarging process is actually performed on a portion that is enlarged and displayed, an interpolating process is performed to increase the number of pixels. As this interpolating process, a spline interpolating process, a sharpness adjustable interpolating process (Japanese Unexamined Patent Publication Nos. 9(1997)-50515 and 9(1997)-93426), etc., can

be applied in addition to an ordinary linear interpolating process.

For the image of a portion to be enlarged and displayed, it is preferable to perform image processing which
5 differs from that performed on the entire image, in order to make observation of fine portions easy.

The indicating mark may be a cursor of the form that indicates mainly one point on an entire image, like an arrow, a cross mark, etc., or may be, for instance, a
10 magnifying-glass icon that indicates an area of a fixed size. In the case of a cursor of the form that indicates mainly one point, the aforementioned "image of a portion" means the image of an area that includes one point and vicinities.

In displaying the image of a portion of an entire
15 image on a larger scale than the entire image, the image of the enlarged portion may be displayed on an area (a window in a multi-window) differing from a display area for the entire image, or may be overwritten and displayed on an area, indicated by the indicating mark, or its vicinity on the
20 displayed entire image. A form of cutting out a portion of an entire image as a window and enlarging and displaying the image of a portion within this window is included. Note that when a magnifying-glass icon is employed as the indicating mark, the aforementioned portion may be enlarged and
25 displayed within the interior area of the magnifying-glass icon.

Furthermore, an indicating mode and a specifying mode may be switched. In the indicating mode, a measuring-point specifying mark in the image of a portion, enlarged according to a ratio of the above-mentioned enlargement, moves in synchronism with movement of an indicating mark in the entire image. In the specifying mode, the indicating mark in the entire image moves in synchronism with movement of the measuring-point indicating mark in the image of a portion enlarged and displayed. That is, if the indicating mark is moved on the entire image to indicate an approximate position of a measuring point in the entire image, the image of a portion, which is enlarged and displayed, and the measuring-point specifying mark are scrolled in synchronism with movement of the indicating mark by the movement amount of the indicating mark multiplied by the enlargement ratio, within the display area (regardless of whether they are displayed on a portion of the display area for the entire image or a multi-window). Conversely, if the indicating mark is caused to move in synchronism with movement of the measuring-point specifying mark, the positional relation between the measuring-point specifying mark in the image of a portion, enlarged and displayed, and the indicating mark in the entire image can be maintained constant at all times. At the same time, the image of a portion, enlarged and displayed, can be prevented from being scrolled excessively by movement of the indicating mark during the

time that the measuring-point specifying mark is moving
finely from point to point for specifying a measuring point
in the image of a portion enlarged and displayed.

Note that in moving both marks in synchronism with
5 each other, the movement amount of the driven mark is
determined based on the enlargement ratio of the above-
mentioned enlargement display.

In a preferred form of the present invention, the
positional information of the measuring point, thus
10 specified on the enlarged and displayed image by the
measuring-point specifying mark, and a result of a
predetermined measurement, made based on this positional
information, are stored as numerical information, as part
of radiation-image information, or as overlay image
15 information which is overlaid on a radiation image and
displayed, as described above. In this case, the overlay
image information may also be stored in a different storage
medium separate from the original radiation-image
information.

20 In accordance with another aspect of the present
invention, there is provided a storing unit comprising:

a storage medium for storing a radiation image
displayed on a display screen of an image display unit, the
radiation image including a measuring point which is a
25 measuring object; and

measurement-information storing means for

relating positional information of the measuring point specified on the display screen to the radiation image and storing the related positional information in the storage medium along with the radiation image.

5 In a preferred form of the storing unit, the measurement-information storing means stores a result of measurement, obtained based on the positional information, in the storage medium along with the radiation image and the positional information.

10 Also, the measurement-information storing means may store the positional information and the measurement result as numerical information. In addition, the measurement-information storing means may store the positional information and the measurement result as image
15 information that is embedded in the radiation image and displayed. Furthermore, the measurement-information storing means may store the positional information and the measurement result as overlay image information that is overlaid on the radiation image and displayed. The operation
20 of "relating positional information of the measuring point specified on the display screen to the radiation image and storing the related positional information in the storage medium along with the radiation image", which is performed by the measurement-information storing means, is not limited
25 to storing the positional information in the same storage medium as the storage medium in which the radiation image

is stored, but also includes storing the positional information and the radiation image in separate storage media, as long as both are caused to correspond to each other.

In another preferred form of the storing unit, the radiation image, which is stored, is an entire image representing the whole of the radiation image and an enlarged image of a portion of the entire image displayed for specifying the measuring point. In this case, the enlarged image may be obtained by enlarging a portion of the entire image displayed on the display screen, indicated by an indicating mark, and also by overwriting and displaying the enlarged portion on an area including the enlarged portion. Also, the enlarged image may be obtained by enlarging and displaying a portion, indicated in the entire image by an indicating mark, on an area on the display screen differing from an area on which the entire image is displayed.

The storing method and storing unit according to the present invention stores both a radiation image, displayed on the display screen of an image display unit, and the positional information of a measuring point, specified on the display screen, in a predetermined storage medium.

Therefore, which part of the radiation image has been measured can be recognized accurately and easily, by displaying the stored radiation-image information along with the positional information afterwards. In addition, a

result of comparative measurement can be accurately obtained by accurately specifying a corresponding measuring point on another radiation image that is a comparing object.

BRIEF DESCRIPTION OF THE DRAWINGS

5 The present invention will be described in further detail with reference to the accompanying drawings wherein:

FIG. 1A is a block diagram showing a radiation-image storing unit constructed according to a first embodiment of the present invention;

10 FIG. 1B is a block diagram showing a radiation-image storing unit constructed according to a second embodiment of the present invention;

FIG. 2 is a block diagram showing a radiation-image measuring apparatus that inputs a radiation image and measurement information to the radiation-image storing units shown in FIGS. 1A and 1B;

FIG. 3 is a perspective view showing the positional relation between first memory and second memory;

FIG. 4 is a diagram showing radiation-image information embedded with measurement information;

FIG. 5 is an exploded view showing an overlay image in which measurement information is overlaid on radiation-image information, the measurement information and the radiation-image formation being displayed on a multi-window;

FIG. 6 is a schematic diagram showing an example

of a data structure in which measurement information is added to radiation-image information;

FIG. 7 is an exploded view showing an overlay image in which measurement information is overlaid on radiation-image information, the measurement information and the radiation-image formation being displayed on a single window; and

FIGS. 8A and 8B are diagrams used to explain how a measurement is made on a single window by the radiation-image measuring apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Fig. 1, there is shown a preferred embodiment of a radiation-image storing unit in accordance with the present invention. The radiation-image storing unit 100 shown in Fig. 1A includes measurement-information storing means 10. Radiation-image information, which represents a radiation image including a measuring point which is a measuring object, is input from a predetermined radiation-image measuring apparatus 200 to the measurement-information storing means 10. Also, measurement information, which consists of the positional information of a measuring point specified by the radiation-image measuring apparatus 200 and a result of measurement based on the positional information of the specified measuring point, is input from the radiation-image measuring apparatus 200 to the measurement-information

storing means 10. The input measurement information is related to the input radiation-image information by the measurement-information storing means 10 and is stored in a predetermined storage medium 300. Note that as shown in Fig. 1B, the radiation-image information may be stored in a first storage medium 300a, while the measurement information related to the radiation-image information may be stored in a second storage medium 300b differing from the first storage medium 300a.

First, the radiation-image measuring apparatus 200 will be described in detail with reference to Fig. 2.

As shown in the figure, the radiation-image measuring apparatus 200 includes overall display means 210. The original radiation image P0 of a human spinal column, including a measuring point which is a predetermined measuring object, is input to the overall display means 210. The overall display means 210 reduces the original radiation image P0 to obtain the entire image P1 of the radiation image and displays the entire image P1 on the left half area of the display screen of an image display unit 400. Also, the radiation-image measuring apparatus 200 includes a first cross cursor C1, enlargement display means 220, and a second cross cursor C2. In the displayed entire image P1, the first cursor C1 is used for indicating a portion of the entire image P1. The original radiation image P0 is also input to the enlargement display means 220. The enlargement display

means 220 enlarges the original radiation image P0 and displays images P2 and P3 on the right half of the display screen of the image display unit 400. In the enlarged radiation image, each of the images P2 and P3 corresponds to a portion consisting of a point indicated by the first cross cursor C1 and an area near this indicated point. In the enlarged and displayed images P2 and P3, the second cross cursor C2 is used to specify K1, K2, etc., which are reference points of measurement (measuring points). The radiation-image measuring apparatus 200 further includes measurement means 250, measurement-result display means 260, mode switching means 240, and a mouse 241. The measurement means 250 calculates a result of measurement (e.g., a distance between the measuring points K1 and K2) in accordance with a predetermined algorithm for measurement previously stored, based on the positions of the specified measuring points K1, K2, etc. The measurement-result display means 260 overlays and displays the obtained measurement result on the entire image P displayed on the display screen of the image display unit 400. The mode switching means 240 switches an indicating mode M1 and a specifying mode M2. In the indicating mode M1, the second cursors C2 in the images P2 and P3 of portions, enlarged and displayed in accordance with a ratio of an enlargement ratio obtained by the enlargement display means 220 to a reduction ratio obtained by the overall display means 210 ((enlargement ratio)/(reduction ratio)),

move in synchronism with movement of the first cross cursor C1 in the entire image P1. In the specifying mode M2, the first cross cursor C1 in the entire image P1 moves in synchronism with movement of the second cross cursors C2 in the images P2 and P3 enlarged and displayed. The mouse 241 is an interface for arbitrarily moving the cursors C1, C2 within the respective display screens, in accordance with each of the aforementioned modes.

The overall display means 210 is constituted by reduction processing means 212, which reduces the input original radiation image P0, and first memory 211, which stores the entire image P1 obtained by the reduction processing means 212. On the other hand, the enlargement display means 220 is constituted by enlargement processing means 222, which enlarges the input original radiation image P0, and second memory 221, which stores the radiation image obtained by the enlargement processing means 222. The positional relation between the first memory 211 and the second memory 222 has previously been determined according to the value of the above-mentioned ratio ((enlargement ratio)/(reduction ratio)), say, 4), with origins O1, O2 as reference, as shown in Fig. 3. That is, 1 pixel on the first memory 211 is equivalent to 4 pixels on the second memory 221. Therefore, if the first cross cursor C1 is moved by 1 pixel within the entire image P1 on the display screen of the image display unit 400, the enlarged and displayed images

P2 and P3 are scrolled by 4 pixels.

The mode switching means 240 is used to selectively switch the indicating mode M1 and the specifying mode M2 by button operation of the mouse 241.

5 Next, the operation of this radiation-image measuring apparatus 200 will be described in detail.

10 The original radiation image P0 is input to both the overall display means 210 and the enlargement display means 220. The original radiation image P0 input to the overall display means 210 is reduced by the reduction processing means 212 and stored in the first memory 211. The reduced image P0 is displayed as the reduced entire image P1 on the left half area of the display screen of the image display unit 400. On the other hand, the original radiation
15 image P0 input to the enlargement display means 220 is enlarged by the enlargement processing means 222 and stored in the second memory 221.

20 At first the mode switching means 240 has already been switched to the indicating mode M1 in which the second cross cursor C2 moves in synchronism with movement of the first cross cursor C1 in the entire image P1. The enlargement display means 220 calculates a point on the enlarged radiation image stored in the second memory 221 which corresponds to the point on the entire image P1 indicated by the first cross
25 cursor C1, and then displays an area near the calculated point on the upper right 1/4 area of the display screen of the image

display unit 400 as the image P2 of a portion enlarged to a size 4 times the original. When the enlarged image P2 is displayed, the second cross cursor C2 is fixedly displayed at the center of the enlarged image P2.

5 If the operator manipulates the mouse 241 to move the first cross cursor C1 on the entire image P1, the enlarged image P2 is scrolled within the display screen for the enlarged image P2 by an amount 4 times the movement amount of the first cross cursor C1, in synchronism with the movement
10 of the first cross cursor C1. If the operator indicates the vicinity of the measuring point K1 on the entire image P1 with the first cross cursor C1 by the mouse 241, the enlarged image P2 including the measuring point K1 is displayed on the upper right 1/4 enlarged-image display area of the display
15 screen. At this stage, the operator performs the operation of switching the indicating mode M1 to the measuring-point specifying mode M2, with respect to the mode switching means 240 by manipulating the mouse 241. This operation releases the fixation on the second cross cursor C2 in the enlarged
20 image P2, and the operator manipulates the mouse 241 to move the second cross cursor C2 so that the second cross cursor C2 is overlaid on the measuring point K1 on the enlarged and displayed image P2. When the second cross cursor C2 moves, the first cross cursor C1 moves slightly on the entire image
25 P1 in synchronism with the movement of the second cross cursor C2 within the enlarged and displayed image P2.

Since the enlarged and displayed image P2 is displayed with resolution 4 times that of the entire image P1, the operator is able to accurately align the second cross cursor C2 with the measuring point K1, on the enlarged and displayed image P2. After alignment, the operator inputs an instruction to determine a specified measuring point to the enlargement display means 220, manipulating the mouse 241.

In response to the instruction to determine a specified measuring point, the enlargement display means 220 inputs the position of the second cross cursor C2 on the enlarged image P2 to the measurement means 250 and fixes the display of the enlarged and displayed image P2.

Subsequently, in order to specify the other measuring point K2, the operator switches the mode switching means 240 to the indicating mode M1 and again moves the first cross cursor C1 on the entire image P1, by manipulating the mouse 241. The enlargement display means 220 calculates a point on the enlarged radiation image stored in the second memory 221 which corresponds to the point on the entire image P1 indicated by the first cross cursor C1, and then displays an area near the calculated point on the lower right 1/4 area of the display screen of the image display unit 400 as the image P3 of a portion enlarged to a size 4 times the original. When the enlarged image P3 is displayed, the second cross cursor C2 is fixedly displayed at the center of the enlarged image P3.

11 1

5 If the operator manipulates the mouse 241 to move the first cross cursor C1 on the entire image P1, the enlarged image P3 is scrolled within the display screen for the enlarged image P3 by an amount 4 times the movement amount of the first cross cursor C1, in synchronism with the movement of the first cross cursor C1. If the operator indicates the vicinity of the measuring point K2 on the entire image P1 with the first cross cursor C1 by the mouse 241, the enlarged image P3 including the measuring point K2 is displayed on the upper right 1/4 enlarged-image display area of the display screen. At this stage, the operator performs the operation of switching the indicating mode M1 to the measuring-point specifying mode M2, with respect to the mode switching means 240 by manipulating the mouse 241. This operation releases the fixation on the second cross cursor C2 in the enlarged image P3, and the operator manipulates the mouse 241 to move the second cross cursor C2 so that the second cross cursor C2 is overlaid on the measuring point K2 on the enlarged image P3. When the second cross cursor C2 moves, the first cross cursor C1 moves slightly on the entire image P1 in synchronism with the movement of the second cross cursor C2 within the enlarged image P3.

25 Since the enlarged image P3 is displayed with resolution 4 times that of the entire image P1, the operator is able to accurately align the second cross cursor C2 with the measuring point K2, on the enlarged image P3. After

alignment, the operator inputs an instruction to determine a specified measuring point to the enlargement display means 220, manipulating the mouse 241. In response to the instruction to determine a specified measuring point, the enlargement display means 220 inputs the position of the second cross cursor C2 on the enlarged image P3 to the measurement means 250 and fixes the display of the enlarged image P3.

The measurement means 250 to which the two measuring points K1 and K2 were input in this way calculates a result of measurement, such as a distance between K1 and K2, in accordance with the previously stored algorithm for measurement, based on the information on the positions of the measuring points K1, K2 on the enlarged images that were input. This measurement result is input to the measurement-result display means 260, which in turn displays the input measurement result (e.g., a numeral "200.5" displayed in the entire image P1 shown in Fig. 2) on the display screen of the image display unit 400.

Note that when an instruction to determine a specified measuring point is input via the mouse 241 by the operator, characters P2 and P3 representing the enlarged images P2 and P3 are further displayed near the points that the first cross cursor C1 indicates on the entire image P1. In the entire image P1, the characters P2, P3 indicate the approximate positions of the enlarged images P2, P3,

displayed respectively on the upper right 1/4 area and lower right 1/4 area of the display screen of the image display unit 400.

In this manner, the radiation-image measuring apparatus 200 displays both the entire image P1 of the radiation image, which makes it easy to grasp the positional relation between the measuring points K1 and K2, and the enlarged images P2 and P3, which render it possible to accurately specify the measuring points K1 and K2, on the same display screen of the image display unit 400. The radiation-image measuring apparatus 200 also displays the areas, indicated by the first cursor C1 for indicating the approximate positions of the measuring points K1, K2 in the entire image P1, as the enlarged images P2, P3. Therefore, the radiation-image measuring apparatus 200 is capable of accurately specifying the measuring points K1 and K2, grasping the positional relation between the measuring points K1 and K2 accurately. As a result, the radiation-image measuring apparatus 200 is capable of making an accurate measurement, based on the measuring points K1, K2 specified in this way.

With the aforementioned operation, the entire image P1 and the enlarged images P2 and P3 displayed on the display screen of the image display unit 400 are input as the radiation-image information P from the overall display means 210 and enlargement display means 220 of the

radiation-image measuring apparatus 200 to the
radiation-image storing unit 100 of the preferred embodiment.
In addition, both the information on the positions of the
measuring points K1, K2 on the enlarged images P2 and P3 (e.g.,
5 a mark " · " representing the positions of the measuring points
K1, K2 and symbols "K1", "K2") and the measurement result
(e.g., a numeral "220.5") are input from the measurement means
250 to the radiation-image storing unit 100 as the measurement
information.

10 The measurement-information storing means 10 of
the radiation-image storing unit 100 causes the input
measurement information to correspond to the measured
positions of the radiation-image information P and then
embeds the measurement information into the radiation-image
15 information P as image information, thereby generating
radiation-image information P' (Fig. 4). The generated
radiation-image information P' including the measurement
information is stored in the storage medium 300 (Fig. 1A).

Thus, in the radiation-image storing unit 100 of
20 the preferred embodiment, the positional information of the
measuring points K1, K2 specified on the display screen of
the image display unit 400 and the measurement information
are stored in the storage medium 300, along with the
radiation-image information P displayed on the display
25 screen. Therefore, which part of the radiation image has
been measured can be recognized accurately and easily, by

displaying the stored radiation-image information P'
embedded with the positional information of the measuring
points and the measurement result, afterwards. In addition,
a result of comparative measurement can be accurately
5 obtained by accurately specifying a corresponding measuring
point on another radiation image that is a comparing object.
Note that even if the radiation image information P is stored
in the first storage medium 300a shown in Fig. 1B and the
positional information of K1, K2 and measurement result
10 related to the radiation image information P are stored in
the second storage medium 300b shown in the same figure, the
same effect can be obtained.

Note that in the radiation-image storing unit 100
of the preferred embodiment, although the measurement-
15 information storing means 10 has generated the
radiation-image information P' by causing the input
measurement information to correspond to the measured
positions of the radiation-image information P and by
embedding the measurement information into the
20 radiation-image information P as image information, the
radiation-image storing unit 100 of the present invention
is not limited to this embodiment. For example, as shown in
Fig. 5, the input measurement information may be generated
as an overlay image Q, which can be overlaid on the
25 radiation-image information P and displayed, and is caused
to correspond in position to the radiation-image information

P, and this overlay image Q may be stored in the storage medium 300 in correspondence with the radiation-image information P. If the radiation-image information and the measurement information are thus generated as separate images P and Q, the overlay image Q can be overlaid on the radiation-image information P and displayed, when the radiation image is displayed afterwards. In addition, when it is unnecessary to display the measurement information, it is also possible not to display the overlay image Q selectively. Therefore, this case is excellent from the viewpoint of practical convenience.

In addition, instead of relating the measurement information to the radiation-image information P as image information, the positional information of a measuring point may be expressed, for example, as a coordinate value (x, y) in an x-y coordinate system in Fig. 3 and the measurement result may also be expressed as numerical information. In this case, as shown in Fig. 6, the positional information and the measurement result are added to image data representing the radiation-image information P, to generate radiation-image data, and the generated radiation-image data is stored in the storage medium 300. As with the above case, in displaying the radiation-image information P, it is possible to not display the positional information and the measurement result selectively when it is unnecessary to display the measurement information. Therefore, this case

is excellent from the viewpoint of practical convenience.

Furthermore, in the radiation-image storing unit of the preferred embodiment, although the entire image P1 and the enlarged image P2 displayed on the different areas of the display screen of the image display unit 400, i.e., images in a multi-window, have been employed as radiation-image information P related to measurement information, the radiation-image storing unit of the present invention is not limited to this embodiment. For instance, as shown in Fig. 7, the measurement information may be stored as an overlay image Q in radiation-image information P, obtained by displaying a movable window W on part of the entire image P and by enlarging the image of a portion of the entire image P displayed within the window W and displaying enlarged images P2, P3.

In the radiation-image measuring apparatus in this case, when the mode switching means 240 is in the indicating mode M1, as shown in Fig. 8A, the entire image P1 within a circular area W, as it is, can be displayed in the same way as the outside area, and the first cross cursor C1 and the circular area W can be moved integrally on the entire image P1. When the mode switching means 240 is in the measuring-point specifying mode M2, as shown in Fig. 8B, the first cross cursor C1 functions as the second cross cursor C2, and within the circular area W, a portion of the enlarged image P2, corresponding to the image of a portion which had

been displayed within the circular area W when the indicating mode M1 is switched to the specifying mode M2, is displayed. The second cross cursor C2 may be movable freely within the enlarged image P2 displayed within this circular area W.

5 Also, by moving the cursor C2 on the entire image P1 integrally with the circular area W by the mouse 241, in the case where the cursor C2 is always fixed at the central portion of the circular area W, the enlarged image P2 displayed within the circular area W can be scrolled so that the measuring point
10 K1 or K2 is aligned with the cursor C2. As a result, positional relation on the entire image P can easily be grasped at the circular area W and the stopped position on the entire image P1 of the cursor C2, while the measuring point K1 or K2 on the enlarged image P2 is being specified
15 accurately.

While the radiation-image storing unit 100 of the aforementioned embodiment has been constructed separately from the radiation-image measuring apparatus 200, it may be formed integrally with the radiation-image measuring
20 apparatus 200. For example, it may be constructed as a radiation-image storing section.

What is claimed is:

1. A storing method comprising the step of:
storing a radiation image displayed on a display
screen of an image display unit, the radiation image including
5 a measuring point which is a measuring object; and
wherein positional information of said measuring
point specified on said display screen is stored in a storage
medium along with said radiation image.
- 10 2. The storing method as set forth in claim 1,
wherein a result of measurement, obtained based on said
positional information, is stored along with said radiation
image and said positional information.
- 15 3. The storing method as set forth in claim 1,
wherein said positional information and said measurement
result are stored as numerical information.
- 20 4. The storing method as set forth in claim 2,
wherein said positional information and said measurement
result are stored as numerical information.
5. The storing method as set forth in claim 1,
20 wherein said positional information and said measurement
result are stored as image information that is embedded in
said radiation image and displayed.
- 25 6. The storing method as set forth in claim 2,
wherein said positional information and said measurement
result are stored as image information that is embedded in
said radiation image and displayed.

7. The storing method as set forth in claim 1,
wherein said positional information and said measurement
result are stored as overlay image information that is
overlaid on said radiation image and displayed.

5 8. The storing method as set forth in claim 2,
wherein said positional information and said measurement
result are stored as overlay image information that is
overlaid on said radiation image and displayed.

10 9. The storing method as set forth in claim 1,
wherein said radiation image is an entire image representing
the whole of said radiation image and an enlarged image of
a portion of said entire image displayed for specifying said
measuring point.

15 10. The storing method as set forth in claim 2,
wherein said radiation image is an entire image representing
the whole of said radiation image and an enlarged image of
a portion of said entire image displayed for specifying said
measuring point.

20 11. The storing method as set forth in claim 3,
wherein said radiation image is an entire image representing
the whole of said radiation image and an enlarged image of
a portion of said entire image displayed for specifying said
measuring point.

25 12. The storing method as set forth in claim 4,
wherein said radiation image is an entire image representing
the whole of said radiation image and an enlarged image of

a portion of said entire image displayed for specifying said measuring point.

13. The storing method as set forth in claim 5, wherein said radiation image is an entire image representing the whole of said radiation image and an enlarged image of a portion of said entire image displayed for specifying said measuring point.

14. The storing method as set forth in claim 9, wherein said enlarged image is obtained by enlarging a portion of said entire image displayed on said display screen, indicated by an indicating mark, and also by overwriting and displaying the enlarged portion on an area including said portion.

15. The storing method as set forth in claim 9, wherein said enlarged image is obtained by enlarging and displaying a portion, indicated in said entire image by an indicating mark, on an area on the display screen differing from an area on which said entire image is displayed.

16. A storing unit comprising:
a storage medium for storing a radiation image displayed on a display screen of an image display unit, the radiation image including a measuring point which is a measuring object; and

measurement-information storing means for relating positional information of said measuring point specified on said display screen to said radiation image and

storing the related positional information in said storage medium along with said radiation image.

17. The storing unit as set forth in claim 16, wherein said measurement-information storing means stores
5 a result of measurement, obtained based on said positional information, in said storage medium along with said radiation image and said positional information.

18. The storing unit as set forth in claim 16, wherein said measurement-information storing means stores
10 said positional information and said measurement result as numerical information.

19. The storing unit as set forth in claim 17, wherein said measurement-information storing means stores
15 said positional information and said measurement result as numerical information.

20. The storing unit as set forth in claim 16, wherein said measurement-information storing means stores
20 said positional information and said measurement result as image information that is embedded in said radiation image and displayed.

21. The storing unit as set forth in claim 17, wherein said measurement-information storing means stores
25 said positional information and said measurement result as image information that is embedded in said radiation image and displayed.

22. The storing unit as set forth in claim 16,

wherein said measurement-information storing means stores said positional information and said measurement result as overlay image information that is overlaid on said radiation image and displayed.

5 23. The storing unit as set forth in claim 17, wherein said measurement-information storing means stores said positional information and said measurement result as overlay image information that is overlaid on said radiation image and displayed.

10 24. The storing unit as set forth in claim 16, wherein said radiation image is an entire image representing the whole of said radiation image and an enlarged image of a portion of said entire image displayed for specifying said measuring point.

15 25. The storing unit as set forth in claim 17, wherein said radiation image is an entire image representing the whole of said radiation image and an enlarged image of a portion of said entire image displayed for specifying said measuring point.

20 26. The storing unit as set forth in claim 18, wherein said radiation image is an entire image representing the whole of said radiation image and an enlarged image of a portion of said entire image displayed for specifying said measuring point.

25 27. The storing unit as set forth in claim 19, wherein said radiation image is an entire image representing

the whole of said radiation image and an enlarged image of a portion of said entire image displayed for specifying said measuring point.

28. The storing unit as set forth in claim 20,
5 wherein said radiation image is an entire image representing the whole of said radiation image and an enlarged image of a portion of said entire image displayed for specifying said measuring point.

29. The storing unit as set forth in claim 24,
10 wherein said enlarged image is obtained by enlarging a portion of said entire image displayed on said display screen, indicated by an indicating mark, and also by overwriting and displaying the enlarged portion on an area including said portion.

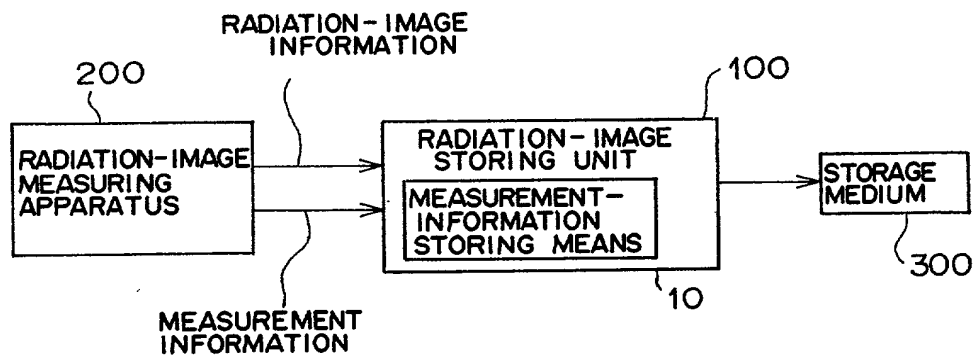
30. The storing unit as set forth in claim 24,
15 wherein said enlarged image is obtained by enlarging and displaying a portion, indicated in said entire image by an indicating mark, on an area on the display screen differing from an area on which said entire image is displayed.

20

ABSTRACT OF THE DISCLOSURE

Radiation-image information is input from a radiation-image measuring apparatus to a measurement-information storing section, and measurement information, which consists of the positional information of a measuring point and a result of measurement based on the positional information, is also input from the radiation-image measuring apparatus to the measurement-information storing section. The measurement information is related to the radiation-image information by the measurement-information storing section and is stored in a storage medium.

F I G . 1 A



F I G . 1 B

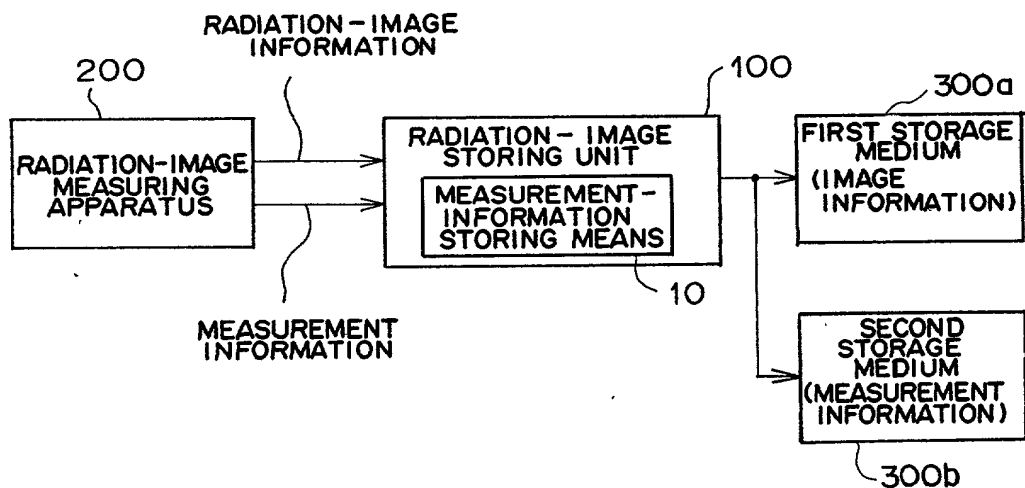
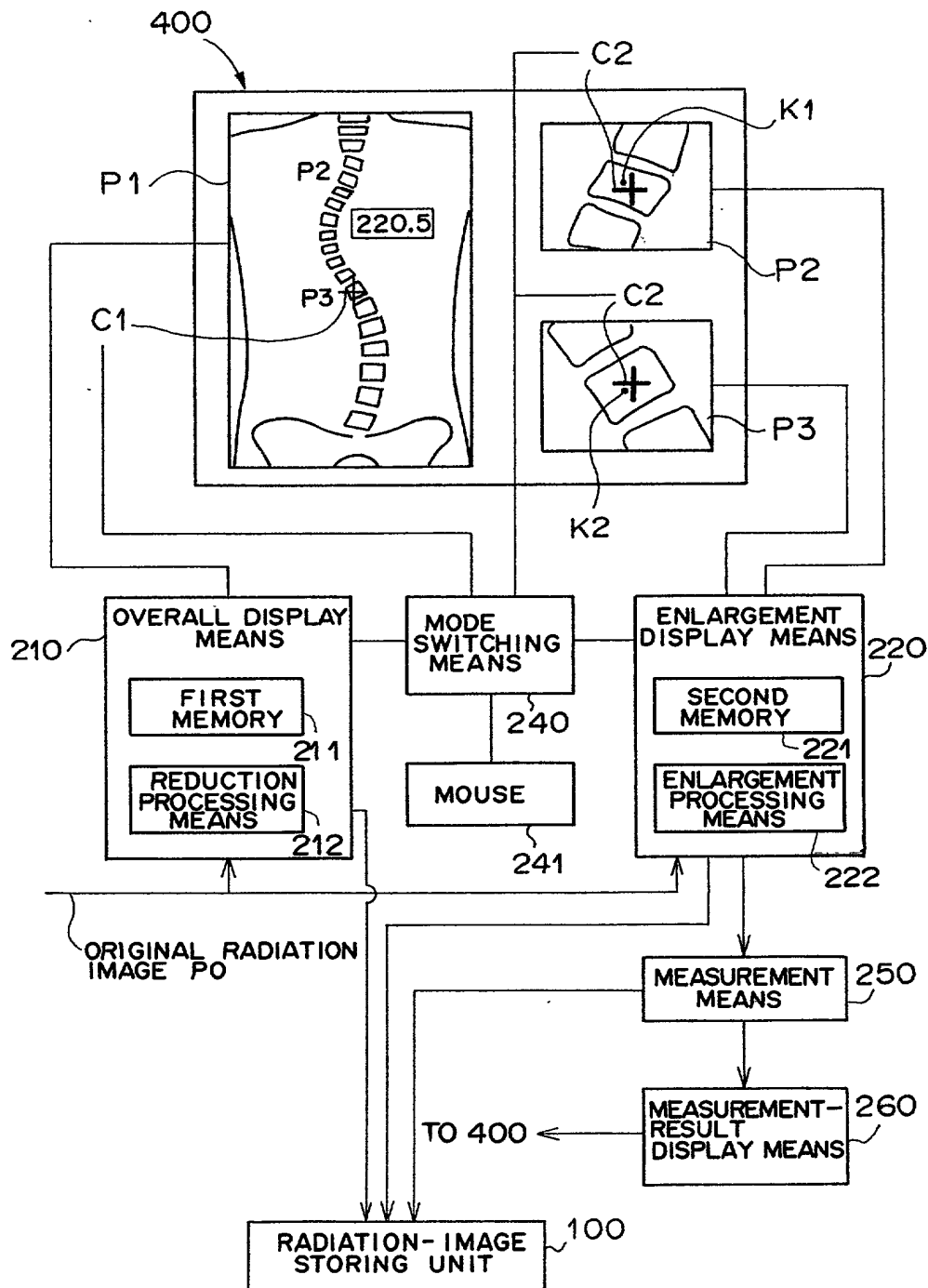
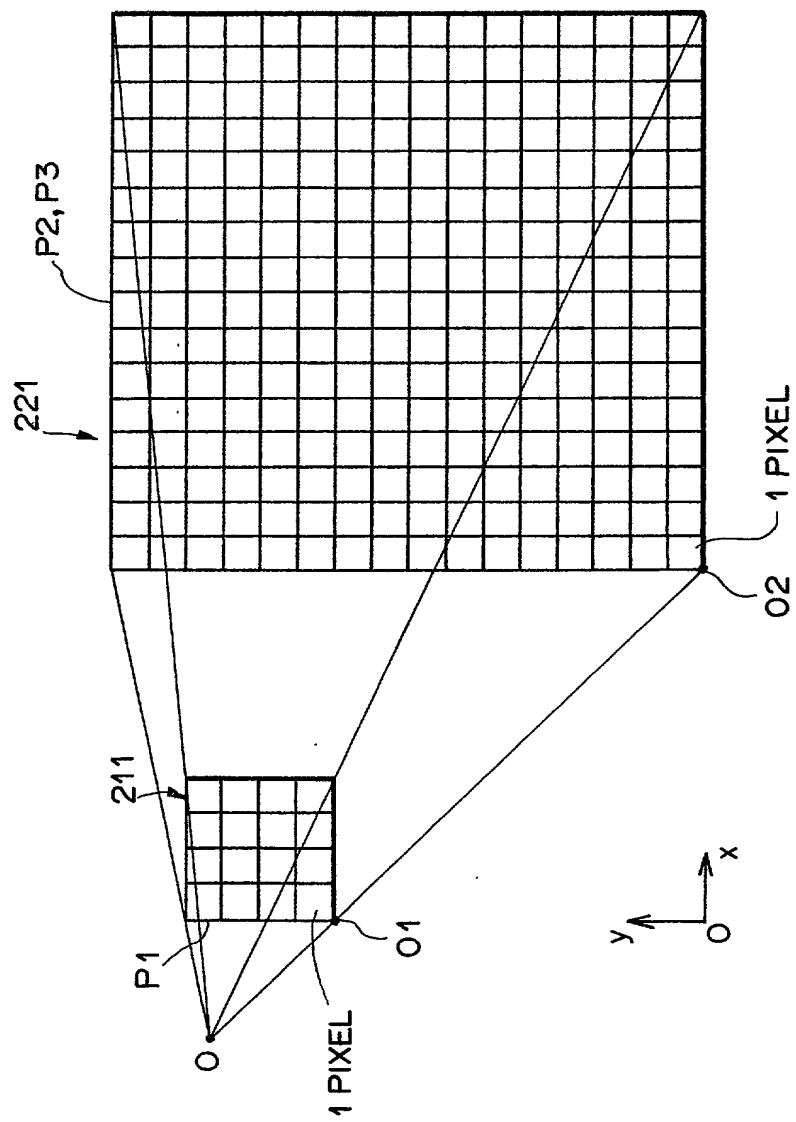


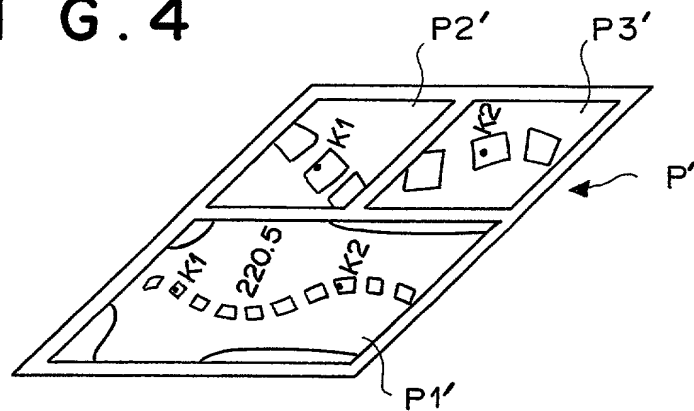
FIG. 2



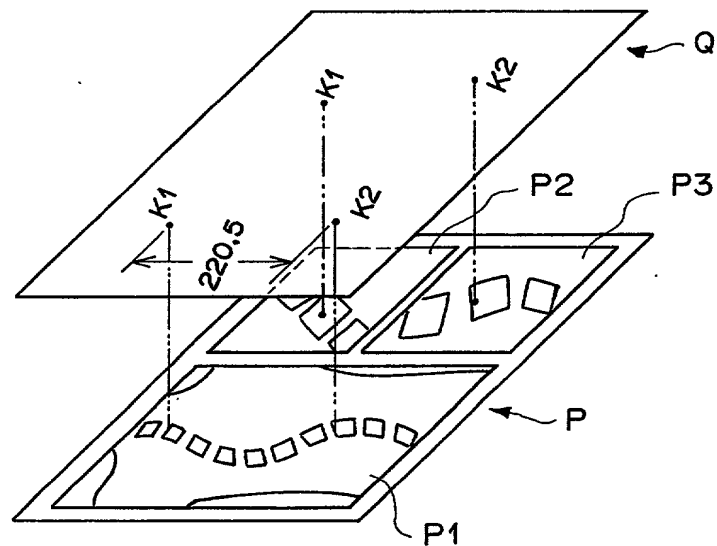
F I G . 3



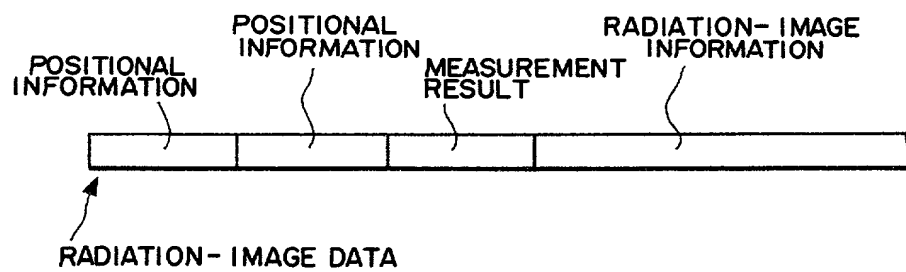
F I G . 4



F I G . 5



F I G . 6



F I G . 7

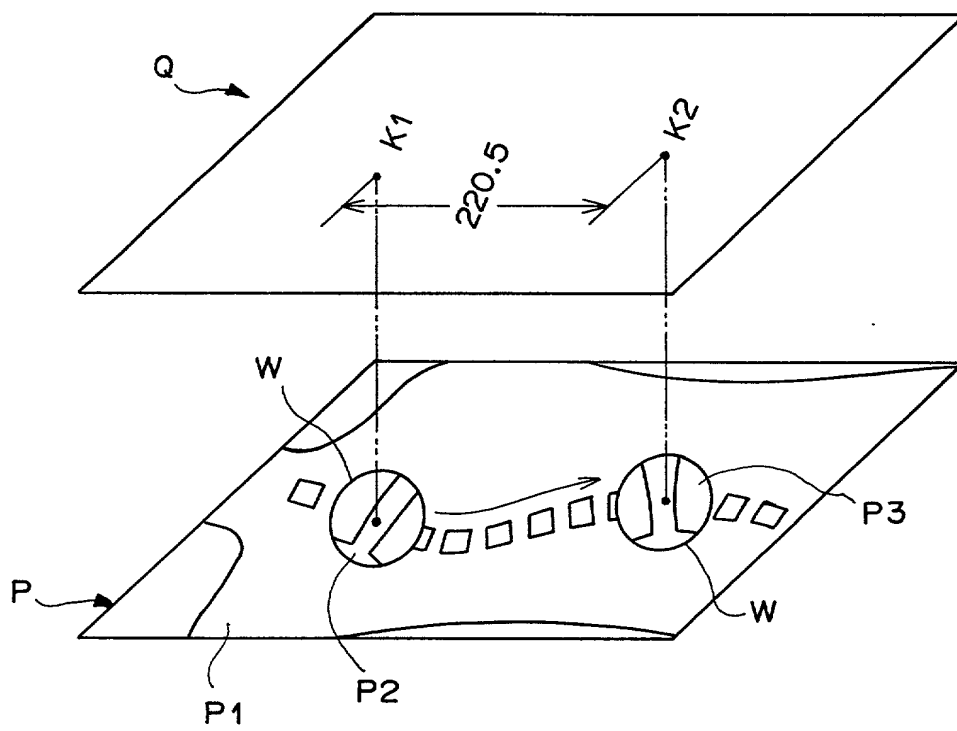


FIG. 8A

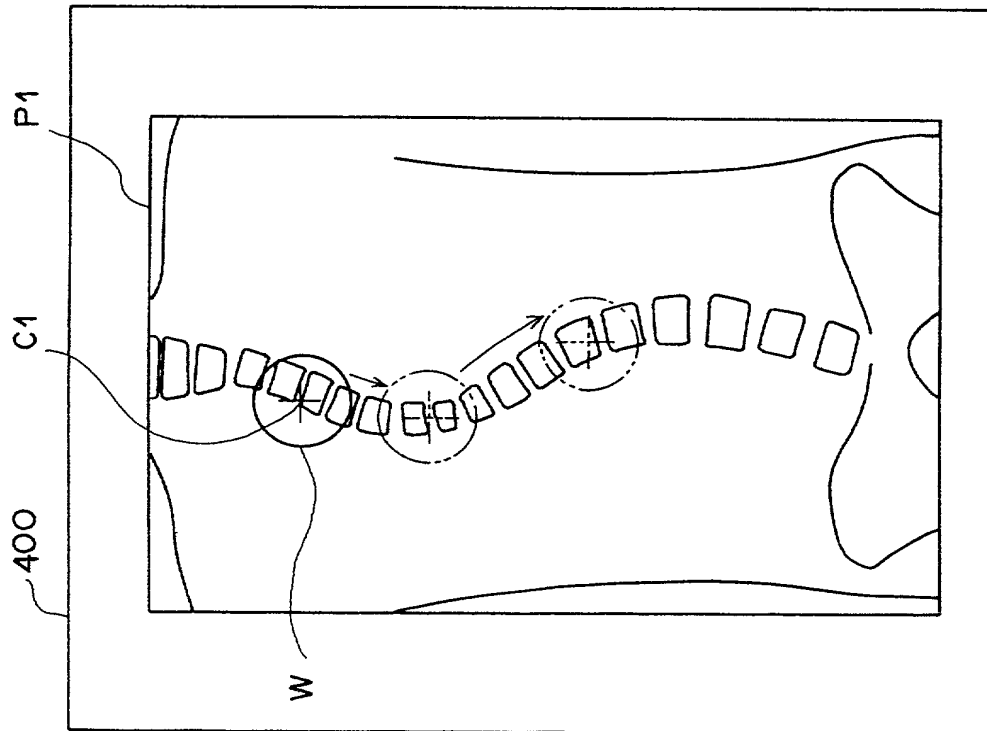
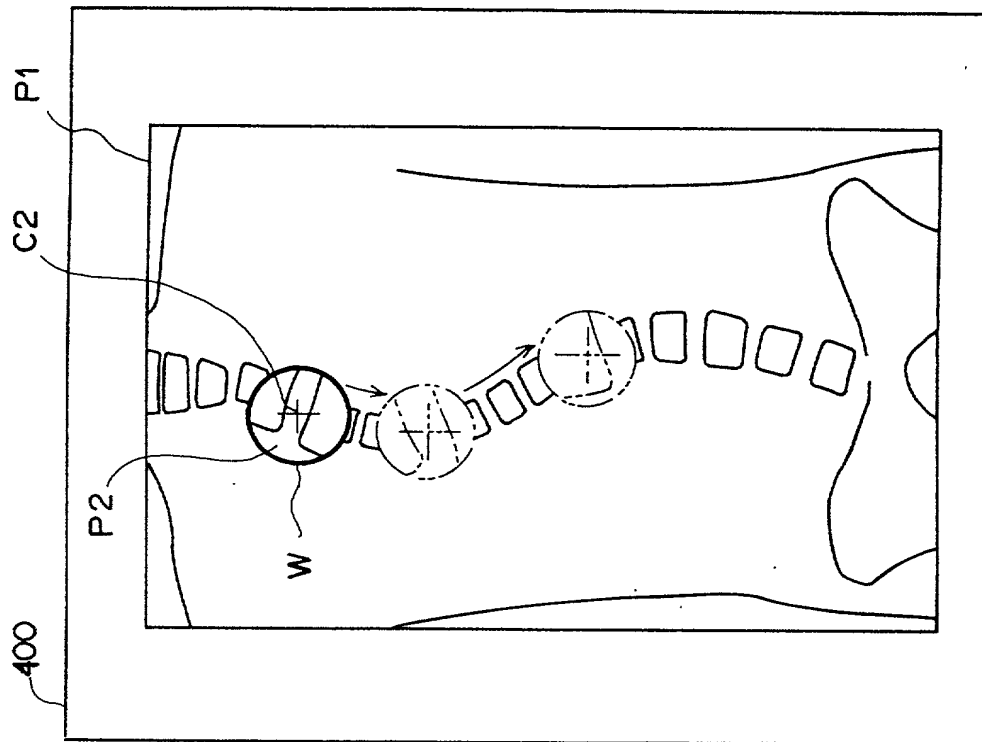


FIG. 8B



Declaration and Power of Attorney for Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。

私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。

下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者(下記の氏名が一つの場合)もしくは最初かつ共同発明者であると(下記の名称が複数の場合)信じています。

As a below named inventor, I hereby declare that:

Masahiko Yamada

My residence, post office address and citizenship are as stated next to my name, c/o Fuji Photo Film Co., Ltd., 798 Miyanodai, Kaisei-machi, Ashigarakami-gun, Kanagawa-ken, Japan. I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

"METHOD AND UNIT FOR STORING A

RADIATION IMAGE"

上記発明の明細書(下記の欄でX印がついていない場合は、本書に添付)は、

the specification of which is attached hereto unless the following box is checked:

☐ ____月 ____日に提出され、米国出願番号または特許協定条約

国際出願番号を ____ とし、

(該当する場合) ____ に訂正されました。

☐ was filed on ____
as United States Application Number or
PCT International Application Number

____ and was amended on

____ (if applicable).

私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

私は、連邦規則法典第37編第1条56項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

Japanese Language Declaration

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私は、米国法典第35編第119条(a)-(d)項又は第365条(b)項に基づき下記の、米国以外の国の少なくとも一カ国を指定している特許協力条約第365条(a)項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願についての外国優先権をここに主張するとともに、優先権を主張している本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

Prior Foreign Applications

外国での先行出願

(patent) 92786/1999

(Number)
(番号)

Japan

(Country)
(国名)

31/03/1999

(Day/Month/Year Filed)
(出願年月日)

Priority Not Claimed
優先権主張なし

☐

(patent) 321463/1999

(Number)
(番号)

Japan

(Country)
(国名)

11/11/1999

(Day/Month/Year Filed)
(出願年月日)

☐

(Number)
(番号)

(Country)
(国名)

(Day/Month/Year Filed)
(出願年月日)

☐

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(Application No.)
(出願番号)

(Filing Date)
(出願日)

(Application No.)
(出願番号)

(Filing Date)
(出願日)

私は、下記の米国法典第35編第120条に基づいて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約第365条(c)に基づく権利をここに主張します。又、本出願の各請求範囲の内容が米国法典第35編第112条第1項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内又は特許協力条約国際出願提出日までの期間中に入手された、連邦規則法典第37編第1条第56項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

(Application No.)
(出願番号)

(Filing Date)
(出願日)

(Status: Patented, Pending, Abandoned)
(現況: 特許許可済、係属中、放棄済)

(Application No.)
(出願番号)

(Filing Date)
(出願日)

(Status: Patented, Pending, Abandoned)
(現況: 特許許可済、係属中、放棄済)

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I hereby claim foreign priority under Title 35, United States Code, Section 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

I hereby claim the benefit of Title 35, United States Code Section 120 of any United States application(s), or 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose any material information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application:

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Japanese Language Declaration

(日本語宣言書)

委任状: 私は、下記の発明者として、本出願に関する一切の手続きを米国特許商標局に対して遂行する弁理士又は代理人として、下記のことを指名致します。(弁護士、又は代理人の氏名及び登録番号を明記のこと)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (list name and registration number)

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